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THE PHYTOGEOGRAPHY AND SYSTEMATICS OF *XANTHISMA TEXANUM* DC. (ASTERACEAE): PROPER USAGE OF INFRASPECIFIC CATEGORIES[1]

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The monotypic genus *Xanthisma* DC. (Asteraceae) includes sufficient variation in its single species *X. texanum* DC. to illustrate the three levels of taxonomically recognized infraspecific variation: subspecific, varietal and formal. Proper usage of the three taxonomic ranks requires consideration of morphological and distributional data according to a consensus of international opinion. Although much has been published on the B-chromosome of the species (see Semple, 1972a), no modern systematic treatment of *X. texanum* has been published. Examination of some five hundred herbarium collections and experimental data indicate that a revision of Gray's 1852 treatment, which was based on only a few specimens, is necessary.

A detailed discussion of the distribution of the species as a whole and each of the infraspecific taxa is warranted for two reasons: first, to document the allopatric condition of the two subspecies, and second, to show that the distri-

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bution of the species is not predictable from the generalized vegetation distributions given by Gould (1962). The Edwards Plateau and its eroded portions are basic considerations in both cases. A taxonomic treatment considering all aspects of the problem is given at the end of the discussion of distribution and morphological variation.

All populations of a species ought to be interfertile to some degree. The validity of treating all the morphological forms of *Xanthisma* as a single species was tested by hybridization experiments involving greenhouse plants grown from fruiting material collected at wild populations. No barriers to fertilization were found and normal chromosome homologue pairing in meiotic prophase was observed in F_1 generation hybrids, which also set viable seed. Cross pollination was accomplished following the procedure of Smith & Parker (1971) and was facilitated by self-incompatibility. Selfing could be induced, but yielded progeny of low fitness. Clearly, Gray's combining all taxa of *Xanthisma* into a single species is acceptable.

DISTRIBUTION OF THE SPECIES

Xanthisma texanum grows in a portion of the central southwest of the United States: Texas, Oklahoma and eastern New Mexico. The known distribution of the species is illustrated in Figure 1 and is based on herbarium collections from GH, KSU, MO, NY, OKLA, SMU, TEX, TTC, US, WIS, and Arizona State University-Tempe.[3] Collections of subsp. *drummondii* (T. & G.) Semple and subsp. *texanum* are represented by dots and stars respectively; var. *texanum* and var. *orientalis* Semple of subsp. *texanum* are represented by encircled and unenclosed solid stars; putative hybrids between the two subspecies are represented by open stars. Treatment of Gray's (1852) varieties as subspecies, a term he did not use (Fernald, 1940), is based upon involucral bract morphology and the nearly allopatric distribution of the two taxa, while the distribution and bract morphology

[3]The assistance of Frederick Utech and Timothy Love at the last two herbaria, respectively, is gratefully acknowledged.

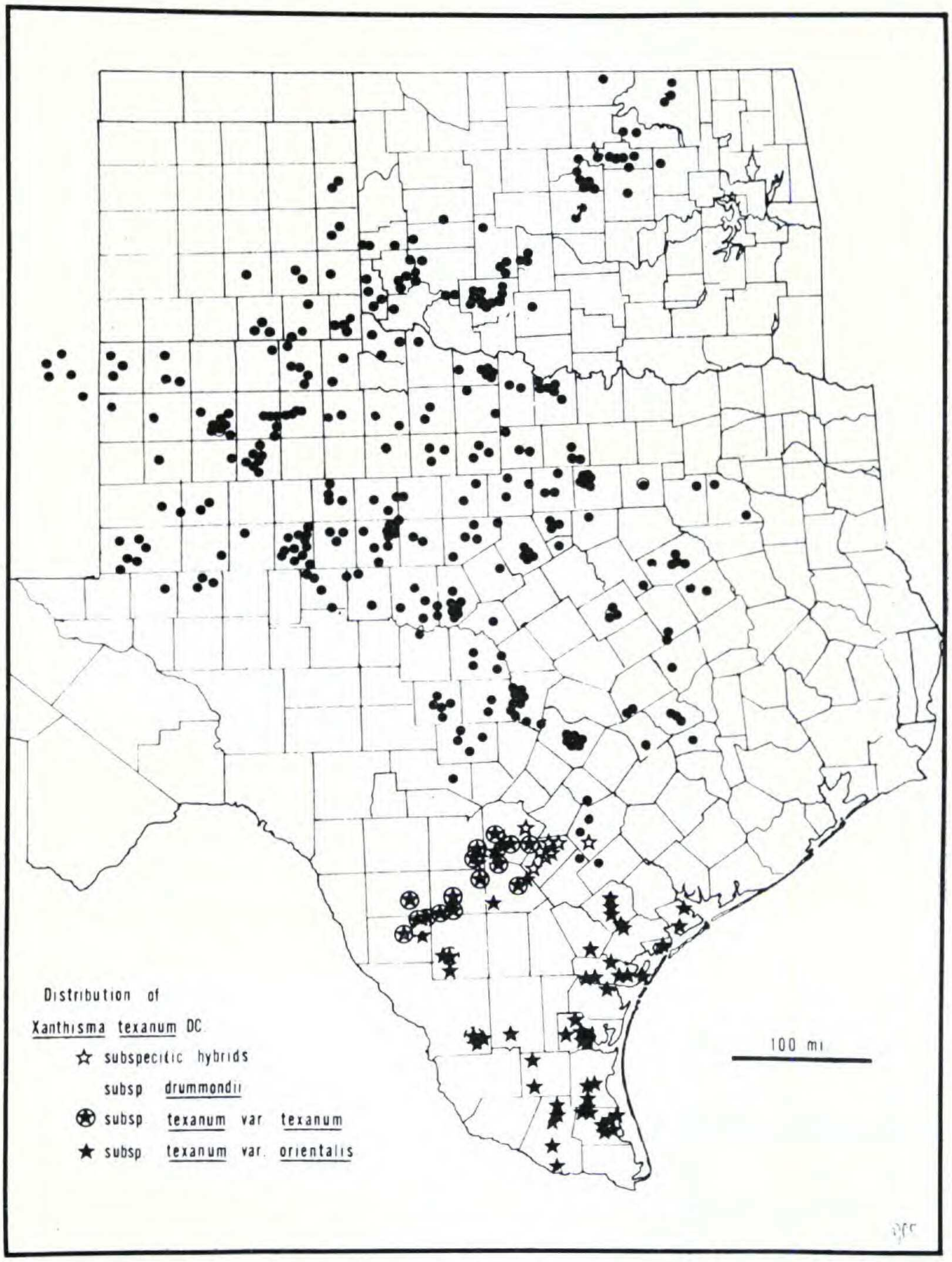


Figure 1. The distribution of *Xanthisma texanum* DC. Locations of collections have been determined from herbarium collections from eleven herbaria cited in the text. A key to the symbols used is given. Collections are plotted on a county outline map of Texas and Oklahoma.

variation within subsp. *texanum* is properly treated at the varietal level. Variation in environmental factors accounts for the species distribution.

Climatic factors determine the extent of the species' range in the east, northwest and south. Too much rain in the east and too little in the north and west are the apparent limiting factors, while increasingly tropical conditions become limiting to the south (Visher, 1954). Local variation in geological factors accounts for the distribution within the range and secondarily along the margins of the range. The western margin of the eastern deciduous forest (Bray, 1906; Tharp, 1926; Braun, 1950; and Gould, 1962) forms the eastern margin of the range of *X. texanum*, which is a member of the ecotone flora *sensu latu* between the forests and grasslands. Reasons for the present location of the forest-prairie ecotone are not appropriate for discussion in this paper.

A detailed treatment of geological influences on the species' range is given by Semple (1972b) and summarized for each taxon under each appropriate heading. The Rio Grande Valley supports a noticeably distinct vegetation community (Foscue, 1932). *Xanthisma texanum* is excluded from the community, which apparently forms a barrier to southward expansion of the range of *X. texanum*, since no collections have yet been made in Mexico. Either the Rio Grand Valley community is an impassible barrier or no inhabitable locations exist in Mexico for *X. texanum*.

DIAGNOSTIC MORPHOLOGY AND DISTRIBUTION OF THE TWO SUBSPECIES

A subspecies is characterized by all members exhibiting a particular morphology distinct from other individuals in the species and by the allopatric distribution of these members from the rest of the species (Du Reiz, 1930; Clausen, 1941; van Steenis, 1957; Valentine & Löve, 1958; and Ehrendorfer, 1968). Those morphologically intermediate individuals between the subspecies and the rest of the spe-

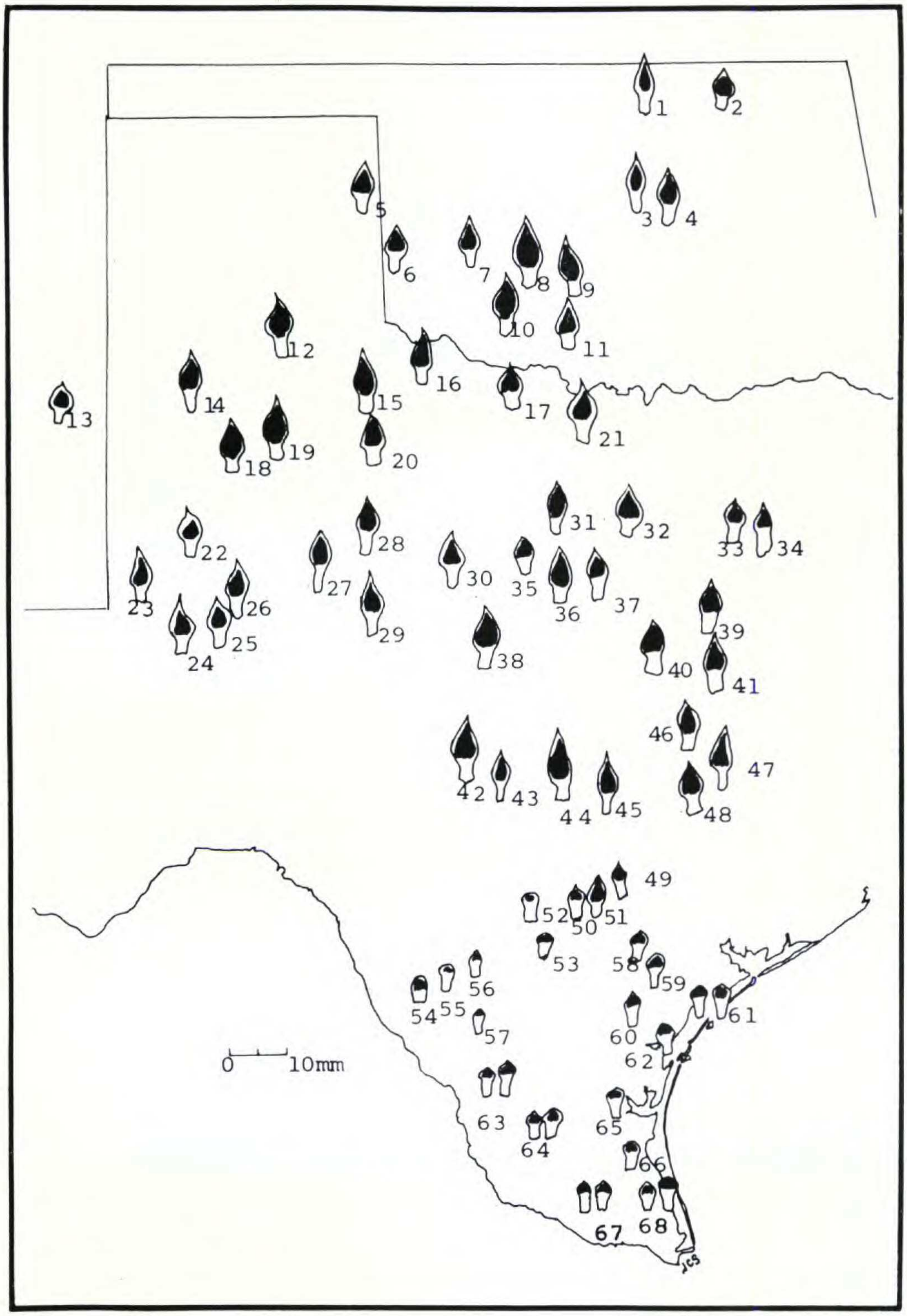


Figure 2. Geographic distribution of involucral bract variation of *Xanthisma texanum* DC. Bracts from plants from 68 populations are illustrated in outline on a map of Texas and Oklahoma. Bracts 1-48 are from individuals of subsp. *drummondii* (T. & G.) Semple; bracts 52-68 are from individuals of subsp. *texanum*; and bracts 49-51 are from putative hybrids between the two subspecies.

cies only occur in populations geographically located between the subspecies and the remainder of the species. Within *X. texanum* all members of subsp. *drummondii* (T. & G.) Semple are distinguished by involucral bracts that are lanceolate and taper to an acute apex. Subspecies *texanum* includes other members of the species and is characterized by involucral bracts that are depressed-ovate in shape and shorter than those of subsp. *drummondii*.

Diagrammatic representations (Figure 2) of involucral bracts typical of those occurring in the middle of the series forming the involucre are superimposed on an outline map of Texas and Oklahoma and were taken from plants occurring in wild populations at the locations indicated. Bracts 1-48 show the similarity that occurs within subsp. *drummondii* (see Figure 3.C for a detailed illustration of a typical involucral bract). Bracts 52-68 illustrate the range of variation in involucral bract shape found in subsp. *texanum* (Figures 3.A and 3.B). Bracts 49-51 illustrate involucral bracts from putative hybrids between the two subspecies and are the only bracts that are intermediate in shape.

The allopatric distribution of the two subspecies is due to the presence of the Edwards Plateau and the Blacklands Prairies between the two taxa. Geologically and topographically the Edwards Plateau is broken up into five regions (Fenneman, 1931; Oetking, 1959; and Raisz, 1957), although Gould (1962) included all the varied vegetation types within a single vegetation region. With a few exceptions, in part due to man's influences, subsp. *drummondii* does not grow in areas overlying uneroded portions of the Edwards Plateau, since the upper strata limit the amount of water available to the shallow rooted plants. Depending upon the extent of erosion and the nature of the underlying bedrock, subsp. *drummondii* grows in varying degrees of commonness in the areas of the eastern portion of the plateau (colloquial sense) in the following manner: common at the lower elevations of the Central Mining District, common throughout the Lampasas Cut Plains and rare on the more northeastern Comanche Plateau. Both subspecies

are absent in the southeastern portion of the Edwards Plateau (the Texas Hill Country). Thus differences in geology account for the different numbers of collections in this well botanized area and also explain the means by which the two subspecies are isolated north and west of San Antonio, Texas.

The presence of the Blacklands Prairies isolates the two subspecies north and east of San Antonio. The prairies, which run from San Antonio to Dallas and further northeastward, are characterized by dark, high clay content soils (Sellards *et al.*, 1966) and are dry and rock hard in the summer. Typically, *Xanthisma* occurs on sandy, light brown or reddish soils. Field work in the central Texas region showed that *X. texanum* is very rare throughout the entire length of the prairies, except for a few individuals surviving on disturbed or introduced soils along highways and river banks. Clearly, Gray's varieties are exemplary of what are today treated as subspecies.

A narrow zone of isolated subsp. *drummondii* populations occurs in Caldwell, Gonzales and Wilson Counties, but the small populations only thrive in favorably moist years. Interestingly, *Heterotheca pilosa* (Nutt.) Shinners and *Bradburia hirtella* T. & G. are common in these counties and further east, the former being the most prevalent yellow flowered member of the Astereae. Similarity in superficial appearance of these two species with *X. texanum* undoubtedly explains confusion about the distribution of *X. texanum* in this critical region between the two subspecies.

DIAGNOSTIC MORPHOLOGY AND DISTRIBUTION OF THE TWO VARIETIES OF SUBSP. TEXANUM

A variety is characterized by all members of a population exhibiting a particular morphology distinct from other individuals in the species. The distribution of these populations is sympatric with populations whose members are not within the same variety, and also many populations of

morphological intermediates exist (Du Reiz, 1930; Clausen, 1941; van Steenis, 1957; Valentine & Löve, 1958; and Ehrendorfer, 1968). By this definition varieties can be recognized within a species, which does not have subspecies. Furthermore, variation that is *not known* to be confined to an isolated group of populations can not be given subspecific status. Van Steenis (loc. cit.) described varietal level variation as being continuous with other varieties, although the continuum would have pronounced modes. The variation between subspecies can be described as discontinuous, except for the few hybrids. Figure 1 illustrates the sympatric condition of the two varieties of subsp. *texanum:* var. *texanum* with obtuse involucral bract apices (Figure 3.A) and var. *orientale* Semple with cuspidate involucral bract apices (Figure 3.B).

FORMAL LEVEL VARIATION IN VAR. ORIENTALIS

Formal level morphological variation is generally regarded as some phenotype possessed by only some members of a population, whereas the subspecific and varietal level phenotypes are possessed by all members of a population. Those individuals in populations of subsp. *texanum* var. *orientale* which exhibit red pigmentation along the lateral margins of the involucral bracts forming the middle and inner series of the involucre have been designated as forma *rubrum* Semple (Figure 3.B). Such individuals are rare, but do occur in populations throughout the range of var. *orientalis*.

GENETIC BASIS OF DIAGNOSTIC CHARACTERISTICS

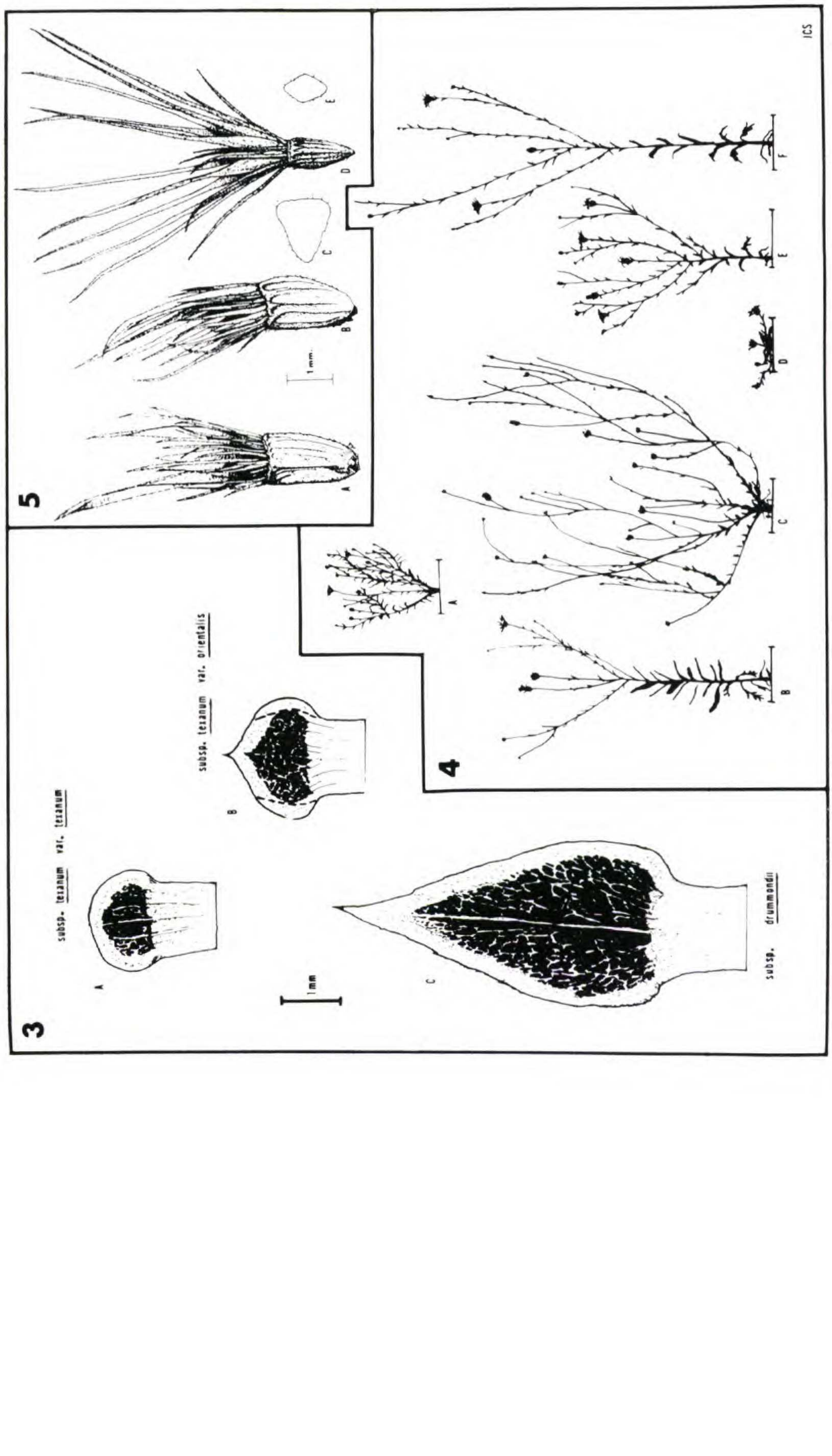
Experiments were conducted to show that all diagnostic characters have a genetic basis. Size but not general shape of the involucral bracts was found to be variable. Lack of sufficient light, available water, amount of soil or a high degree of crowding all resulted in smaller bracts being formed than those bracts formed by the individual when sufficient quantities of soil, light and water were provided.

The maximum size was determined by heredity and not the environment. Therefore size should be considered secondarily to shape in determining the proper identity of a particular collection.

The red pigment of f. *rubrum* was found to be passed from one generation to the next in var. *orientale*, but was never seen in var. *texanum* or in subsp. *drummondii*. Although the pigment is not always present in detectable quantities, its importance warrants some taxonomic status, since *Xanthisma* has always been previously described as monochromous. However, in some experimental plants heads were occasionally produced which manifested the red pigment in the distal portion of the ray straps on the adaxial surface and on the lobes of the disc florets, but only on the last day or two of disc anthesis. Most individuals produced enough pigment to give the rays an orange hue, but one plant produced rays that were deep rust red. Such variation in intensity of color does not occur on bract margins. No documentation of bicolor rays in wild plants exists.

HABIT AS AN EXAMPLE OF VARIATION NOT WARRANTING TAXONOMIC STATUS

Despite the great range of variation in habit occurring in the species, no one form was found to warrant taxonomic recognition. Within a single population long-stemmed and short-stemmed individuals were found in nature. The distribution patterns of the short-stemmed plants (Figure 4.C) and the stemless plants (Figure 4.D) suggest that these forms are ecotypes, since they have a genetic basis. The extremes of short-stemmedness and stemlessness only occur in populations of var. *orientale* and western populations of subsp. *drummondii*, respectively. The existence of a full range of intermediates between the extremes and the long-stemmed forms (Figures 4.B, 4.F and 4.G) in most populations makes taxonomic recognition unjustified.


5
A
B
C
D
E
1 mm.
4
A
B
3
subsp. texanum var. texanum
subsp. texanum var. orientalis
subsp. drummondii
1 mm

A COMMENT ON CHEMICAL STUDIES

The taxonomic treatment that follows is based on morphology and distribution. Two dimensional paper chromatograms were run on leaf and flower extracts of specimens of each taxon. In general, subspecies *texanum* had fewer compounds than subspecies *drummondii*, and var. *orientale* has fewer compounds than var. *texanum*. In var. *orientale* individuals of forma *rubrum* had one compound, an unidentified anthocyanin (Semple, 1972b), not found in other individuals of the species. The full significance of the chemical studies can only be known upon complete identification of each compound. The preliminary results show that chemical data support the taxonomy. The chemical studies will have meaning in work on determining the evolution of the taxa described.

TAXONOMIC TREATMENT

The most recently published treatment of the genus *Xanthisma* is in Correll & Johnston (1970). The following detailed description of the genus is more complete and ac-

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Figure 3. Involucral Bracts of Infraspecific Taxa. Each bract shown is typical of those in the middle of the series forming the involucre: (A) subsp. *texanum* var. *texanum;* (B) subsp. *texanum* var. *orientale* Semple (dashed lines indicate the extent of red pigment on the margins of bracts of f. *rubrum* Semple); (C) subsp. *drummondii* (T. & G.) Semple.

Figure 4. Habit Variation of *Xanthisma texanum* DC. The baseline under each silhouette equals one decimeter. Each form shown illustrates the habits of experimental plants and represents naturally occurring forms. Plants were grown under similar conditions from fruiting material collected at wild populations. All plants were from different populations, except (B) and (C). See the text for a full discussion.

Figure 5. Heterocarpic Fruit of *Xanthisma texanum* DC. Ray and disc florets produce different kinds of fruit: (A), (B) and (C) are radial, tangential and diagrammatic cross-sectional views of a ray fruit; (D) and (E) are radial and diagrammatic cross-sectional views of a central disc fruit. Peripheral disc fruit are larger and angular ovate in cross-section.

curate in light of the findings of my investigations. The previously unreported heterocarpic fruit condition is also described (Figure 5). A complete list of specimens examined in the study is given in Semple (1972b) and only representative specimens are cited here.

Xanthisma DC., Prodr. 5:94-95. 1836.

Centauridium T. & G., Fl. N. Amer. 2:246. 1842.

Taprooted annuals, rarely biennial and flowering the second season; branches ascending, few to many. Leaves alternate, the upper sessile, the lower terminally serrate; basal leaves petioled, lobed or pinnatifid to bipinnatifid. Heads solitary; involucre turbinate to hemispheric or campanulate; involucral bracts broad in 3-4 series, imbricate, stiff, the margins pale; ray florets pistillate, fertile, yellow; disc florets perfect, fertile, yellow. Fruit heterocarpic with pappus bristly and margins finely serrate; both fruit kinds with fine ascending white hairs, straw-colored when mature and darkening with age. Receptacle slightly convex, with subulate chaff reticulately dispersed between the fruits.

The genus is monotypic and is endemic to the central southwestern areas of the United States.

Xanthisma texanum DC., Prod. 5:95. 1836.

Lectotype: Texas; Bexar County, in woods near Medina, May 1828, *Berlandier* 2039d (G!). Isolectotypes; G! (4), GH! (1), NY! (1), and US! (2).

Herbs 2-7 (rarely more) dm tall, branching near the middle to ground level from a main stem 0.1-3 dm long, or rarely acaulescent. Upper leaves 1-2 cm long, linear, entire; basal leaves 5-8 cm long, ovate to obovate in outline, intergrading above. Heads solitary, not crowded; involucre 5-10 mm high, involucral bracts 1.5-4 mm broad, rarely recurved, margins pale (the lateral margins very rarely red), the central portion green, reticulate venation pronounced, the inner-most bracts chartaceous, the outer-most linear grading into the peduncle bracts; ray florets 10-30, the straps 8-15 mm long, yellow adaxially, pale yellow

abaxially (rarely red-tinted abaxially); disc florets many 40-150, slightly ampliate to tapering, the lobes short. Ray floret cypselas curved obpyramidal, triangulate in cross-section, the pappus grading from short linear to long basally broad scales; disc floret cypselas obovate radially and narrowly-so tangentially, the central fruits rhombic in cross-section, the outer obtrullate, the pappus in two whorls, the inner members ca. 6 mm long, linear, 8-15, the outer members 3 mm long or less many.

The species is characterized by the following combination of characters: heterocarpic fruit with a pappus of bristly scales only, fruit pubescence of long white ascending hairs, receptacle slightly convex with a persistent reticulate network of subulate scales.

The lectotype of the species was chosen from five specimens seen on microfilm only (IDC micro edition of Candolle Prodromi Herbarium). Since all five specimens are similar in quality, the specimen with the complete label giving collection number, date and location, and floral color (fourth from the left on the microfilm) is designated lectotype. Torrey (1859) first noted the typographic error in the Prodromus, which cited the type collection as *Berlandier* 2639 rather than *Berlandier* 2039.

Key to Infraspecific Taxa

I. Involucral bracts shorter than wide above the widest part, 1.5-3.5 mm wide and 1-2 mm long above the widest part. ..... subsp. *texanum* (1)

II. Involucral bracts rounded with little or no flare 1 mm from the apex, occasionally recurved. ..... var. *texanum* (2)

II. Involucral bracts obtusely pointed, the deltoid portion 2-3 mm wide and 1.5-2 mm long above the widest part. ..... var. *orientale* (3)

III. Lateral margins of bracts whitish. ..... f. *orientale* (3a)

III. Lateral margins of bracts red. f. *rubrum* (3b)

I. Involucral bracts longer than wide above the widest part; deltoid portion 2.5-5 mm wide and 3.5-8 mm long in bracts of the middle series. . . ssp. drummondii (4)

1. **Xanthisma texanum** spp. **texanum**

Xanthisma texanum var. *berlandieri* Gray, Smiths. Contrib. Knowl. 3(5) : 98. 1852.

Xanthisma berlandieri (Gray) Small, Fl. SE. U.S. p. 1184. 1903.

This subspecies includes the type collection of *X. texanum* and is distinguished by small involucral bracts with rounded or obtusely pointed apices. Two varieties are recognized within the subspecies.

2. **Xanthisma texanum** ssp. **texanum** var. **texanum**

The type variety of the species is distinguished by its small apically rounded involucral bracts 1.5-2 mm wide, appressed or rarely recurved; generally 30-35 bracts are visible without removing the outer series. The variety is endemic to the Nueces Plains of southern Texas from San Antonio to the south and west. East of San Antonio this variety forms hybrids with subspecies *drummondii*.

SOME REPRESENTATIVE SPECIMENS EXAMINED. TEXAS: Atascosa Co., Charlotte, 4 May 1919, *Schulz* 39 (US). Bexar Co., San Antonio, 4 June 1948, *Burr* 21 (NY, TEX), in woods near the Medina River, July 1829, *Berlandier* 629 (GH, MO, NY, US). Dimmit Co., Big Wells, 21 April 1945, *Shinners* 7,400 (NY, OKLA, SMU, TEX), in front of cemetery, 6 May 1964, *Turner* 4,996 (TEX). Frio Co., Dilley, 6 mi. W, 8 July 1970 *Lewis* 7,634 (MO). La Salle Co., Artesia Wells, 3 mi. W., 7 April 1963, *Dickey* 170 (SMU, TEX). Medina Co., Farm Rd. 1343, 4.4 mi S of U.S. Hwy. 90, 29 June 1972, *Semple & Shea* 720 (MO); Devine, 3 mi. SW, 1 May 1954, *Tharp & Turner* 3,439 (OKLA, TEX). Zavala Co., Batesville, 6 mi. E, 6 May 1964, *Turner* 5,002 (TEX).

3. **Xanthisma texanum** ssp. **texanum** var. **orientale** Semple, var. nov.

Involucri bracteae parvae manifeste depresse ovatae, apice obtuse, cuspidatae, interdum marginibus lateralibus rubris.

HOLOTYPE: Texas: Hidalgo Co.: 13.5 mi. N. of Edinburg on U. S. Hwy. 183, 8 July 1970, *W. Lewis* 7642 (MO). Isotypes: four, to be distributed.

The involucral bracts are small and pronouncedly shield-shaped, occasionally with red lateral margins. The apices are obtusely cuspidate.

This variety is distinguished by the 2-3.5 mm wide involucral bracts having obtuse, cuspidate apices. The short stem habit is also frequently encountered. Hybridization with var. *texanum* is common, but is unknown with ssp. *drummondii*. The name is taken from its distribution in the eastern half of the range of ssp. *texanum*. Two forms are recognized.

3a. **Xanthisma texanum** var. **orientale** Semple f. **orientale**

The type form is the most common form of the variety.

SOME REPRESENTATIVE SPECIMENS EXAMINED. TEXAS: Aransas Co., Aransas Refuge, 29 Sept. 1944, *Cory* 45, 895 (NY, TEX). Bee Co., Beeville, 21 June 1935, *Drushel* 9,941 (NY). Brooks Co., Hebbronville, 15 mi. E, 25 Nov. 1962, *Dohnke* 7 (SMU). Calhoun Co., Port Lavaca, 14 June 1953, *Johnston* 53.280.157 (OKLA, TEX). Goliad Co., Goliad, 15.9 mi. S, 9 July 1970, *Lewis* 7,655 (MO). Hidalgo Co., Rio Grande Valley, 8 Aug. 1942, *Walker* 70 (KSU, TEX). Jim Hogg Co., Hebbronville, 8 mi. E, 8 July 1970, *Lewis* 7,638 (MO). Jim Wells Co., Premont, 12 mi. N, 24 Nov. 1954, *Johnston* 542,144 (TEX). Kenedy Co., King Ranch, Norias Div., 24 Nov. 1953 *Johnston* 53.280.154 (OKLA, TEX.) Kleberg Co., Kingville, 1940, *Sinclair* s.n. (TEX). Refugio Co., 5 mi. S of county line on U. S. Hwy. 77A, 12 June 1971, *Semple* 581 (MO). San Patricio Co., Aransas Pass, 24 May 1922, *Schulz* 868 (TEX, US). Near San Patricio, May 1834, *Berlandier* 2573 (GH, MO, NY). Webb Co., Mirando City, 31 Aug. 1936, *Baird* s.n. (NY). Willacy Co., Yturria Station, 6 Aug. 1924, *Runyon* 664 (TEX, US).

3b. **Xanthisma texanum** var. **orientale** f. **rubrum** Semple, forma nov. Involucri bracteae cum marginibus lateralibus rubris.

HOLOTYPE: Texas: San Patricio Co., 0.5 mi. E. of Ingleside on Texas Hwy. 361, 13 June 1971, *Semple* 602 (MO). Isotype: one to be distributed.

This form is distinguished from the type form by having bracts with red lateral margins.

REPRESENTATIVE SPECIMENS EXAMINED. TEXAS: Aransas Co., Aransas Refuge, 29 Sept. 1944, *Cory* 45,895 (MO). Goliad Co., General Zaragoza State Park, 1 mi. S, 12 June 1971, *Semple* 579 (MO). Kenedy Co., Raymondville, 16 mi. N, 2 Dec. 1945, *Cory* 51,493 (US). Willacy Co., Port Mansfield, 0.5 mi. W of beach by garbage dump, 9 July 1970, *Lewis* 7,644 (MO).

4. **Xanthisma texanum** DC. ssp. **drummondii** (T. & G.) Semple, stat. nov.
Centauridium drummondii T. & G., Fl. N. Amer. 2: 462. 1842.

SYNTYPES: Texas, north of San Antonio, *Riddell* s.n. (NY!); Texas, exact locality unknown, Nov. 1835, *Drummond* 227 (GH!, NY!).

LECTOTYPE: *Drummond* 227 (GH). Isolectotypes: GH, NY.

Xanthisma texanum var. *drummondii* (T. & G.) Gray, Smiths. Contrib. Knowl. 3(5): 98. 1852.

Xanthisma drummondii (T. & G.) Hooker f., Curtis' Bot. Mag. 33: t. 6275. 1877.

Subspecies *drummondii* is distinguished by its involucral bracts, which are wider than those of ssp. *texanum* and are distinctly lanceolate. Populations occur in much of Texas north of San Antonio, and in Oklahoma and eastern New Mexico.

Drummond 227 (GH) was selected lectotype because it is the largest and most complete specimen. The Riddell collection cited by Torrey & Gray (1842) is fragmentary and a putative hybrid between the two subspecies.

SOME REPRESENTATIVE SPECIMENS EXAMINED. NEW MEXICO: Roosevelt Co., Elida, 5 mi. NE, 28 Sept. 1965, *Anderson* 3,004 (KSU). Lingo, 1.2 mi. N, *Semple & Shea* 705 (MO). OKLAHOMA: Beckham Co., Carter, 5 mi. S, 5 July 1965, *Thomas* 79 (OKLA). Caddo Co., Cement, 27 June 1936, *Demaree* 13, 133 (NY). Comanche Co., Cache, June 1927, *Ortenburger* s.n. (U.S.) Creek Co., Drumright, 10 June 1935, *Fry* 8 (OKLA). Custer Co., Clinton, 28 June 1966, *Ganz* s.n. (ARIZ. ST. U.). Grady Co., Verdun, 25 June 1963, *Pearce* 885 (OKLA, SMU). Greer Co., Granite, 17 June 1939, *Graumanns* 85 (OKLA). Harmon Co., Vinson, *Shinners* 31,644 (SMU). Jackson Co., Duke, 1.7 mi W. 15 July 1970, *Flyr* s.n. (MO). Kay Co.; 26 July 1898, *White* s.n. (US). Kiowa Co., Mt. Park, 23 June 1913, *Stevens* 1,293 (OKLA).

Lincoln, 23 Aug. 1895, *Blankenship* 17,334 (WIS). Logan Co., Guthrie, 12 July 1916, *Keyser* 6,036 (NY). Osage Co., 8 mi. S of Kans. state line on Okla. Hwy. 99, 24 June 1972, *Semple & Shea* 667 (MO). Oklahoma Co., Oklahoma City, 27 May 1937, *Waterfall* 582 (OKLA, NY). Pawnee Co., Pawnee, 8 mi. E, 8 June 1934, *Brodell* s.n. (TEX). Payne Co., Mulhall, 1.1 mi. N, 25 June 1972, *Semple & Shea* 674 (MO). Stephens Co., Duncan, 8 mi. N, 27 May 1960, *Waterfall* 15,911 (OKLA). Washita Co., 2.2 mi. E of county line on Okla. Hwy. 152, 20 Aug. 1970, *Semple & Love* 264 (MO). TEXAS: Andrews Co., Andrews, 4 mi. W, 28 May 1956, *Turner* 3,957 (TEX). Archer Co., Mankins, 2 mi. NE, 8 June 1956, *Shinners* 23,758 (SMU). Baylor Co., Seymour, 4 Aug. 1955, *Shinners* 20,776 (SMU). Blanco Co., Silverton, Farm Rd. 145, 26 June 1972, *Semple & Shea* 699 (MO). Burleson Co., Caldwell, 14 June 1971, *Semple* 625 (MO). Burnet, 8 mi. W, 19 May 1955 *Turner & Johnston* 2,480 (TEX). Callahan Co., Baird, Aug. 1882, *Letterman* 26 (MO, US). Childress Co., Childress, *Biology Class C. High School* 12 (TEX). Coke Co., Robert Lee, 3 mi. S, 4 Oct. 1968. *Gary* 192 (TTC). Comanche Co., Comyn, *Theney School* s.n. (TEX), Dallas Co., Dallas, near Comanche Peak, Aug. 1877, *Reverchon* s.n. (US). Dewitt Co., western part of Co., 20 July 1941, *Reidel* s.n. (TEX). Erath Co., 1922, *Gaugh* 29 (US). Fisher Co., Rotan, 10 Sept. 1933, *Brooker* s.n. (TEX). Gaines Co., Lamesa, 15.1 mi. W, 14 Sept. 1946, *Whitehouse* 16,788 (NY, SMU). Gillespie Co., Cherry Spring, 18??, *Jermy* 639 (MO). Gonzales Co., Cost, 11.5 mi. SW, 29 June 1972, *Semple & Shea* 730 (MO). Hall Co., Turkey, 5 mi. S, 12 June 1950, *Tilton* T.550.604 (TTC). Hood Co., 6 Aug. 1877, *Reverchon* 1368 (KSU, NY, US). Howard Co., Big Spring, 22 mi. S, 27 April 1963, *Dallas* 64 (OKLA). Kerr Co., 6 June 1929, *Whitehouse* 7.056 (TEX). Limestone Co., Kosse, 3.5 mi. N, 14 June 1971, *Semple* 626 (MO). Lubbock Co., Lubbock, *Demaree* 7,715 (MO, TEX, TTC, US). McCullogh Co., 1 mi. S of Colorado R., 28 June 1972, *Semple & Shea* 716 (MO). Navarro Co., Corsicana, 21 June 1872, *Hall* 311 (GH, MO, NY, US). Robertson Co., Calvert, 8 May 1904, *Tyler* s.n. (US). Tarrant Co., Lake Fort Worth, 16 July 1923, *Ruth* 742 (GH, KSU, US, WIS). Travis Co., Austin, 9 June 1908, *Biltmore* s.n. (US). Van Zandt Co., Edom, 3 July 1939, *Ball* 7 (SMU). Washington Co., 20 May 1938, *Brackett* s.n. (TEX). Young Co., Belknap, 6 May 1858, *Hayes* 397 (NY).

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MISSOURI BOTANICAL GARDEN
ST. LOUIS, MO. 63110

A WHITE-FLOWERED FORM OF UTRICULARIA PURPUREA FROM NEW HAMPSHIRE. A white-flowered form of *Utricularia purpurea* Walter was found while conducting research in a small pond in New Hampshire. This form was extremely abundant forming extensive mats on the surface of this shallow pond. None of the normal purple-flowered plants were observed. Plants commonly associated with the white form were *Utricularia vulgaris* L., *Utricularia intermedia* Hayne and *Najas flexilis* Rostk. & Schmidt. The pond had a pH of 6.5 and methyl orange alkalinity reading of 8.0 mg/1.

The following form is described. *Utricularia purpurea* Walter forma **alba** Hellquist, forma nova. differt forma purpurea quantum flores albos non purpureos habet. TYPE: NEW HAMPSHIRE: CARROLL COUNTY: small unnamed pond southeast of Dorr Pond on N.H. Route 153 at the settlement of Woodman, Town of Wakefield (U.S.G.S. quadrangle Newfield, Me.-N.H.), *C. B. Hellquist* 8935 (NHA).

The holotype has been placed at the University of New Hampshire Herbarium (NHA). Isotypes are in the herbarium of the New England Botanical Club (NEBC) and Boston State College Herbarium.

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